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WHAT IS A DESMID?

BY PROF. ARTHUR MEAD EDWARDS.

In the language of science, as put upon paper by one of its most zealous devotees, Desmids, or as they are more correctly designated, Desmidiaceæ, are "fresh-water, figured, mucous and microscopic algæ, of a green color." This author also tells us in similar language that the characteristics of these fresh-water forms are "transverse division mostly complete, but in some genera incomplete. Cells or joints of two symmetrical valves, the junction always marked by the division of the endochrome, often also by a constriction. Sporangia formed by the coupling of the cells and union of their contents."

We have here then, in brief, what a Desmid is, and now let us see if we can make this very concise, scientific and correct definition and reply to our question, plain to unscientific minds.

The difficulties attendant upon the study of these Desmids have perhaps, tended to frighten away even professed naturalists from a field of enquiry teeming with promise of results of the greatest interest and profit. At least then we have arrived at the knowledge of one fact, and that is, that a Desmid is a plant, or a member of the vegetable kingdom. This point, it is true, is all but universally acknowledged by every one who pretends to any acquaintance whatever with these creations, and therefore for the time being we will take it for granted that such is the case. In fact it is true that there is no one essential point in which they differ from the other minute plants which have been included under the designation of Protophytes; this name having been applied to them on account of the simplicity of their structure, ranking them as *first plants* in the vegetable system. But, although the name Protophyte was first bestowed for this reason alone, there seems to be good grounds for supposing that it has been very aptly applied, for naturalists are strongly of opinion that the first forms of vegetable life which made their appearance upon the surface of the globe belonged to this group, and we see them at the present day occurring as the harbingers of more complex plants in pools and ponds, on rocks and by road-sides. The amount of study that has been bestowed upon the Desmids is really very great, but it has been by a special class of observers who have been in the habit of not trusting to the revelations of their unassisted eyes, but have called in the aid of all the contrivances of modern mechanical skill as embodied in that perfect instrument of research, the achromatic microscope. By such students we are assured that in no respect do they really approach the animal kingdom. Many arguments, it is true, have been from time to time advanced in support of their animal affinities, but these have all been determined, now that their life history and that of many other undoubted and undisputed plants have been better understood, to be but strongly indicative of their vegetable nature. But the very fact that for a long time they continued to be bandied from one kingdom to the other, now plants and then animals, only to become plants again, indicates the difficulties attendant upon their study, and the uncertain tenure with which they, even now, hold the position they by courtesy are permitted to occupy.

Ehrenberg, the great German microscopist, asserted that one of the Desmids, known by the name of Closterium, possesses true organs of motion, which it protrudes through apertures in its extremities, and keeps in continual action. Unfortunately, however, more recent investigation has revealed the fact that this statement is wanting in accuracy. No such organs of propulsion are to be seen now that we are possessed of much better microscopes than the Prussian philosopher was wont to use, therefore we can but ascribe the "feet" of his Closterium to defective methods of observation. Many if not all of the Desmids, it is true, possess the extraordinary power of slowly changing their place, so that in time, varying with the particular forms observed, they approach the side of the bottle in which they are enclosed, upon which the most light shines, and not only so, but many appear to have a continual but steady progressive mode of motion, as when viewed by means of the microscope they are observed to traverse the field of view under the eye of the observer. Yet it cannot be said that this faculty allies them to animals, for not only do the seeds and similar parts of many plants move about in an extremely vigorous manner, but many undoubted Protophytes do so likewise. Motion is not and cannot at the present day be considered as indicative of aught else but change, physical or chemical, else might a grain of gum-camphor darting about upon the surface of a glass of water, be classed among vital organisms.

Doubtless many persons who see the question placed at the head of this article have noticed some bright pool of fresh water, by the road-side or in a field, upon a spring or summer's day, and observed that it was either filled with a seemingly gelatinous mass of light green matter, or had patches of darker green floating upon its surface. This was an indication that Protophytes or simple plants were present, and, although there are chances that such an accumulation of vegetation contains, or even entirely consists of, other organisms, yet in a number of cases hardly anything but Desmids will be there found. To collect these little wonders we have various methods suited to their mode of occurrence, and it will be well to indicate them.

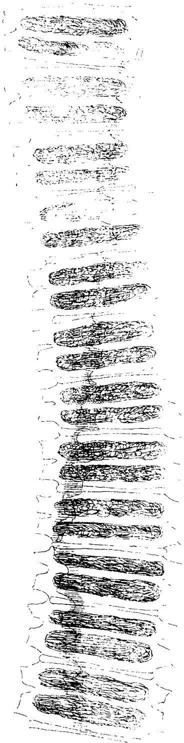
First, then, they are inhabitants of fresh water, and in fact of the freshest kind of water only, decaying animal matter which would cause the water to become foul, even in a very slight degree, being sufficient to kill these tender plants and cause them to be replaced by forms of much greater simplicity. Certain brackish and marine organisms, which were at one time supposed to belong to this family, have been since proved not to be members of it. It has been said that hardly a specimen of fresh water can be found that does not serve as the habitation of Desmids, but such is not strictly the case, although it is true that they are very widely distributed, and one intending to study them should have no difficulty in procuring specimens for examination. In clear pools, in open exposed situations, they occur in the greatest abundance, the largest species being generally found nearest the bottom. Sometimes they are to be found adhering in large quantities to some of the submerged aquatic plants that grow in such localities, forming investing films of a bright green color, which can be removed from its support, or is best gathered along with it. At other times they rest as a thick coating upon the bottom, or float in the form of a bright green scum upon the surface; but the last mode of occurrence is by no means common, the green-colored film seen so frequent upon pools not being Desmids but members of a group into which have been placed the Protococcus, Euglenia, and the so-called "Red-snow." Of these we may have something farther to say hereafter, as they are possessed of wondrous characteristics, and present subjects well worthy the study of any one having a microscope. The brownish scum which is so commonly seen in marshes and ponds does not consist of Desmids either, but is mostly made up of myriads of plants very nearly related to them, and familiarly known as Diatoms. These, again, are of extreme beauty, and at the present day hundreds of microscopes are turned towards them endeavoring to fathom their mysteries, and the optician's skill has been brought to bear upon the construction of lenses specially for the purpose of studying their life, history, and structure.

The Desmids, *Desmidieæ*, or, more correctly speaking, *Desmidiaceæ*, have had this designation applied to them from their form, that is to say, on account of their being made up of two symmetrical halves, united together by means of a band or bridge, so to speak. They are very striking and beautiful objects when examined by means of sufficiently powerful magnifying glasses, many of them requiring for the elucidation of their structure to be amplified at least five hundred diameters, or two hundred and fifty thousand times superficially; microscopists being in the habit of speaking of the magnification of an object in diameters, that having been found to be the most convenient method of expressing the fact, the number of times which the object is amplified superficially, being, of course, formed by squaring the diameter. But a power much less than five hundred diameters, say about two hundred and fifty, is often sufficient to exhibit the general characteristics of most of the Desmids and their allies, the other Protophyta. Thus examined they present most striking objects, and at once become favorites with the amateur microscopist on account of their very marked peculiarities, great beauty, and the variety of forms which they exhibit in outline, as well as the mathematical symmetry of their markings and appendages. The most distinctive characteristic which they at once present is the bilateral structure of their so-called fronds. In the more complex water-plants, or algæ, the term frond is used to designate the whole plant, which in that case is of some degree of complexity, but here is extremely simple, and yet the same name must be made use of, as the entire individual is enclosed in one envelope and constitutes but a single cavity. As such cavities are called cells the Desmids are hence known as unicellular plants. The individual plant among the Desmids and their near relatives, the Diatoms, is often spoken of as a frustule, as the frustule of Closterium, a frustule of Navicula, these being the distinctive names given to two groups, or genera, of Desmids and Diatoms respectively. So in the organisms under consideration, the frustule is said to be a single cell, and this is shown to be the case by the fact that when a fracture takes place of the investing membrane, at any one part, the whole contents escape therefrom. In a few instances this apparent bilateral symmetry is not so evident as in others, or even seems to be entirely absent, but on careful examination it will still be seen to be present, for the constriction in the outer coat, which is made of the substance called cellulose, may be slight or very great, cutting the individual, as it were, into two parts. External warty or spinous protuberances, or processes, are very commonly present, and then the outline of the plant is of great beauty, the green cell-contents, made up for the most part of the same material as constitutes the coloring matter of the leaves of larger plants, and there called chlorophyl, but in the Desmids known as endochrome, causing them to appear almost like brilliant gems of great purity of tint and configuration. In some cases no such external projections are present, but yet the outline of the cell is, nevertheless, extremely graceful. In the Diatoms the cell-wall is strengthened and supported by having deposited within it a mass of silicious material which then becomes marked with wonderfully fine tracings and sculpturings, but in the Desmids no such stony and indestructible substance is present, stiff cellulose only constituting the skeleton of the plant. Hence we do not find the remains of these organisms occurring fossilized in the older strata of the globe as is very commonly the case with the Diatoms. It is true that in some of the flints, hornstones and cherts, certain curious forms have been detected which have been supposed to be the remains of Desmids, but careful examination by competent authorities has tended to prove that such is not the case, but that these are most likely only the skeletons of animals very nearly allied to, if not identical with, the sponges. The true cellulose character of the cell-wall of the Desmids is proved by the action upon it of iodine assisted by sulphuric acid, in which case it is colored blue. In all cases this tough membranous material is surrounded by a perfect and distinct, although not always readily seen, sheath of a gelatinous character, which in some cases, is very broad, but in others is extremely thin.

The outline of the Desmids, although always preserving a more or less perfect bilateral symmetry, varies very greatly. Thus in Closterium, a genus of very general distribution, and one at the same time which includes a great number of species, the general form is a round tube, more or less pointed at both ends, and with the apices both bent over in the same direction so that the individual is somewhat moon-shaped, or more like two cows' horns united base to base. When Closterium is examined with care by means of a good microscope, it is found to have its bright green cell-contents arranged longitudinally in seeming uncertain bands, which coalesce more or less, and hence are not always to be distinguished. But at the ends of the frustule are to be seen apparent organs of wondrous characters, and whose office has not as yet been determined. And the extreme minuteness of the whole plant presents great difficulties to its proper study, so that it is hardly to be wondered at that the functions of its integral parts should not be thoroughly comprehended. These seeming organs are spaces or vacuoles separated from the rest of the cell-contents, and generally of a spherical form, transparent and colorless. Within them, however, are observed numerous minute granules formed of a material of different density, as is shown by their effect upon light. And these are continually, in the healthy individual, in motion, moving about with a trembling and seemingly excited action, putting one in mind of the swarming of a crowd of bees, and hence it is often spoken of as swarming. Besides this, however, there is still another kind of motion to be seen within the Closterium cell-wall, and one at the same time perhaps of greater wonder and perplexity than that already mentioned, as the mode of motion is a problem as yet unsolved. This is the circulation or rotation of much of the liquid contents of the individual Desmid; more especially that transparent and colorless portion which lies just within the membranous cell-wall and its lining tissue, called by the German naturalists the primordial utricle, and overlying the more solid green mass of endochrome and starchy matter; for it has been found that these wonderful little plants contain starchy matter very much after the manner of their gigantic fellows of the field and forest. Members of the genus Closterium have been found to afford the best subjects for witnessing this phenomenon, but the use of a good microscope, and a very careful arrangement of the focus of the lens, are always necessary to display it in a manner at all satisfactory. Some observers assert that they have observed this circulation of fluid, not only within the primordial utricle, but between it and the cellulose covering; however this must be a difficult thing to see, as these membranes are very closely united in most cases. Along the convex edges of the cell, when a magnifying power of about four hundred diameters is employed, it is not very difficult to see indications of this, what may be called "sap-motion" first spoken of, especially if the specimen under examination be one in a vigorous state of growth. Then there may be seen broad streams of fluid flowing over the whole surface of the endochrome, passing from the ends towards the centre and back again; and these streams seem to detach and carry with them, from time to time, little oval or globular bodies, which, on account of their action upon the light, doubtless resulting from their peculiar chemical composition, are readily seen, and any of them may be singled out and its whole course from one part of the frustule to another traced. Some observers state that these minute granules, which seem to be starchy in their composition, are thus carried on to the chambers or cavities at the end of the Closterium, and there join the bodies which are in trembling motion, as has been described; but my experience has been that such is not the case, as the number of the terminal granules does not increase, as would certainly be the case if this addition took place. On the contrary I have often watched a single such granule caught in and carried along by the current of the flowing sap, up towards the cavity at the end, and down again towards the centre, which it reached only to again pass on up, or was arrested in its course and stopped by the way. Again I have often observed that whilst these granules were in themselves passive, and appeared to be but carried along by the stream, and were at the same time all but colorless, the uneasy little dots at the ends of the frustule were in themselves motive, and usually more or less colored, generally of a light brown tint. However this may not be always the case as we cannot, for certain, reason as to what would take place under particular circumstances in the vegetable kingdom, from what we see occurring during the prevalence of peculiar conditions. The current within individuals of Closterium, and its allied genus Penium, as they have been observed by me, would seem to be from the middle towards the ends externally, or against the primordial utricle, and then turning upon itself down again beneath or interiorly against the mass of endochrome in and along the lighter colored interspaces of that mass, which cause it to assume the coarsely banded appearance so very commonly to be seen.

One observer, named Osborne, has thought that this circulation of fluid within the Desmids—for it is by no means peculiar to Closterium or even Penium, but can be observed in several genera, although not so markedly as in these two—is caused by the waving about of little hairs, or ciliæ, as they are called, from their resemblance to eyelashes, set upon the frustule both within and without its cell-wall; but hardly any one else has been able to see any such ciliæ, and an excellent authority upon the microscope, Dr. Carpenter, says, "although the circulation is an unquestionable fact, yet I have no hesitation in regarding the appearance of ciliary action as an optical illusion due to the play of the peculiar light employed among the moving particles of the fluid; the appearance which has been thus interpreted being producible at will by a particular adjustment of the illumination, but being undiscoverable when the greatest care is taken to avoid sources of fallacy." Mr. Osborne also thought he had detected external apertures in the cell-wall of Closterium, at about the locality where Ehrenberg had placed his "prehensile organs," or "feet," which, of course, were necessarily present, whilst he considered the Desmids as animals. Dr. Carpenter says with regard to this, "I must confess to a similar scepticism respecting the external apertures said by Mr. Osborne to exist at the extremities of Closterium; for whilst their existence is highly improbable on *a priori* ground, Mr. Wenham (than whom no observer is entitled to more credit) states that 'not the slightest break can be discovered in the laminated structure that the thickened ends display.'" My observations coincide exactly with those of the last gentlemen, and in fact the same is the opinion of all competent and unprejudiced observers at the present day. Most, if not all the Desmids, have the power of changing their place by sailing, slowly it is true, through the water, though not exhibiting the liveliness so evident in the Diatoms. But that they do move can be shown by shaking them up with some mud, and then covering them with water in a saucer, and placing them where the direct sunlight, or even light reflected from the sky, can fall upon the surface, when, after a time, it will be seen to become green, and the Desmids are found to have congregated at the point nearest the light; in this respect exhibiting their vegetable nature, for we know that plants love the light and will tend towards it whenever they can do so.

An individual of Closterium is represented in Plate 5, fig. 10, and the vacuoles at the ends containing the motile granules are there seen, as well as indications of the circulation of the cell-contents spoken of. The mode of growth and reproduction of the Desmids are very remarkable and of great interest, but we must leave the consideration of



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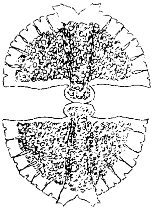

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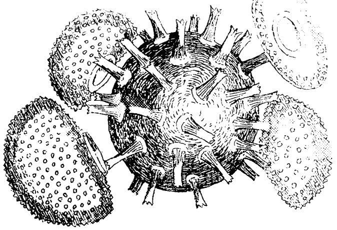

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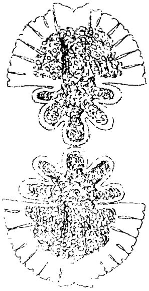

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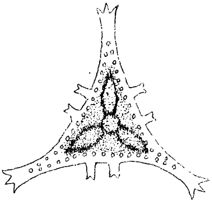

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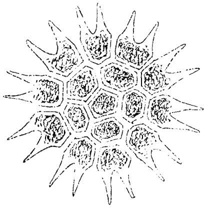

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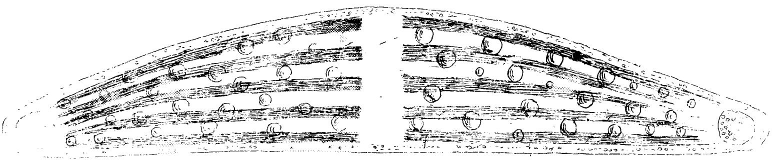

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them to some future time, only now referring to our plate, where several forms of these beautiful plants are represented illustrating the grace and symmetry exhibited in these simple organisms.

EXPLANATION OF PLATE 5.

Fig. 1. *Closterium*, conjugating.
Fig. 2. *Desmidium*, side view.
Fig. 3. *Desmidium*, front view.
Fig. 4. *Cosmarium*.
Fig. 5. *Cosmarium*, conjugating, and forming a Sporangium resembling the so called Xanthidia found in flints.
Fig. 6. *Micrasterias*, subdividing or growing.
Fig. 7. *Micrasterias*, subdividing or growing.
Fig. 8. *Staurastrum*.
Fig. 9. *Pediastrum*.
Fig. 10. *Closterium*.

REVIEWS.

THE HARRIS CORRESPONDENCE.[*]—Well do we remember the delight and lively interest we felt when for the first time we were allowed to look over the Harris manuscripts, after they came into the possession of the Boston Society of Natural History. There were files of letters from Curtis, Doubleday, Hentz, Leconte and Herrick, with notes from entomologists of greater celebrity, and others of lesser fame, with a number of manuscript books filled with long extracts from the works of Godart, Latreille and Olivier, in the concise and beautiful handwriting of this painstaking and precise man; copies of his own letters to his correspondents, illustrated with occasional pen and ink sketches, often of unusual fidelity and finish, of which we have fac-similes in the work before us, and three volumes of drawings, plain and colored, often made with great care,—all evidences of great industry and ability, and of the highest interest to a young naturalist away from instructors of eminence, as showing the methods of studying natural history,—being the chips, models and half-finished undertakings of a working naturalist. Such is the Harris Correspondence, and we have said nothing of the qualities of heart, the geniality, strong human sympathies and undying love of nature that crop out in the letters, published and unpublished, of one who, all in all, must rank as the first among American entomologists.

In this very attractive volume, adorned with an excellent portrait on

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[*] Entomological Correspondence of T. W. Harris, M. D. Edited by S. H. Scudder. Occasional Papers of the Boston Society of Natural History. I. Boston, 1869. 8vo, pp. 375, $5,00. To be had of the Naturalist's Book Agency.